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The Fine Particle Emissions Information System: A New Public Data Bank

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The Fine Particle Emissions Information System is designed to contain source test data including particle size distributions; chemical,physical, and bioassay testing results performed on particulate samples; design and performance data on particle control systems applied; process descriptions of the sources; and descriptions of the sampling equipment and techniques employed.

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the fine particle emissions information system: a new public data bank

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The Fine Particle Emissions Information System (FPEIS) is a computerized follow-on of the Fine Particle Emissions Inventory developed by Midwest Research Institute in 1971 as part of the Particulate Systems Study. A plan to update the 1971 inventory was initiated in July 1974 by the Industrial Environmental Research Laboratory (IERL) at Research Triangle Park, NC. By early 1975, the planned update of the Fine Particle Emissions Inventory was supplanted by the concept of a computerized information system on fine particle emissions from stationary sources. The Fine Particle Emissions Information System is designed to contain source test data including particle size distributions; chemical, physical, and bioassay testing results performed on particulate samples; design and performance data on particle control systems applied; process descriptions of the sources; and descriptions of the sampling equipment and techniques employed.

The Midwest Research Institute (MRI) Fine Particle Emissions Inventory[1] has become one of the most widely quoted reference documents in use by engineers and scientists today who are engaged in studies of fine particles. Since 1971, several questions have been raised regarding the validity of some of the fine particle data in the inventory. Furthermore, advances in fine particle measurement technology and increased fine particle sampling with determination of the size distribution of the particles have led to the availability of more reliable fine particle emissions data. For these reasons, a comprehensive revision of the 1971 inventory was initiated by IERL-RTP and MRI. Since the number of fine particle source tests is expected to increase in the years to follow, it is apparent that an automated data system will be needed if the inventory of fine particle emissions is to be kept current.

The Fine Particle Emissions Information System (FPEIS) was initiated in early 1975 to provide a current, flexible data base of the fine particle emissions data. In addition to containing source process information and particle size distribution data, the FPEIS scope was expanded to include design and operating data on applied particulate control technology, a description of the sampling equipment and method used,

and the results of physical, chemical and biological analyses of the collected samples. To ensure compatibility with other EPA data bases, FPEIS uses the same classification system for sources as NEDS (i.e., the Source Classification Codes)[2] and uses the SAROAD/SOTDAT[3] chemical identification scheme for the chemical analysis data. In order to permit effective use of FPEIS by engineers, scientists, and technicians engaged in fine particle control research and development, a standard protocol for units and terminology has been developed for FPEIS.

The FPEIS is being implemented at the EPA National Computer Center (NCC) at Research Triangle Park on the UNIVAC 1110 computer using SYSTEM 2000, a flexible data base management system being used extensively by EPA and other Government agencies. SYSTEM 2000, which was developed by MRI Systems, Inc., of Austin, Texas (no relation to Midwest Research Institute), provides FPEIS users with several powerful features which will enable users to sort, compare and retrieve information from FPEIS in any arrangement or manner that they choose. SYSTEM 2000 is compatible with existing mathematical and statistical computer programs which can be utilized for a more comprehensive analysis of the FPEIS data.

At present, FPEIS has been implemented on the computer at RTP and the initial loading of source test data has been completed. To date, Midwest Research Institute has accumulated source test data from almost 100 sources and a total of about 1000 test runs. An assessment of this initial loading of data has been conducted by Midwest Research Institute and the result has been compiled into a summary report. In addition, Midwest Research Institute and MRI Systems have collaborated in the preparation of a comprehensive Reference Manual[4] and User Guide.[5]

It is expected that many users will have specific requests for data sorting and reporting which will differ from that in the FPEIS Summary Report.[6] Periodic updating of the User Guide and the Reference Manual will provide users with a catalog of tools for utilizing the data in the system. In addition, the FPEIS data base will be updated with new testing data on a periodic basis to ensure that the data base is kept current. A FPEIS Summary Report will be compiled and published for each update.

Origin of FPEIS

Before discussing the specific data items in the data base, it is appropriate to examine the origin of the FPEIS concept in detail. A national fine particle emissions inventory was published in 1971 by Midwest Research Institute based upon 1969–1970 data then available. In preparing this inventory, MRI acquired and analyzed available data on particle size distributions from both controlled and uncontrolled sources, typical fractional efficiency curves for specific control devices, the degree of application of control equipment to specific sources, and mass emissions factors. The accuracy and precision of the inventory was restricted, however, by the lack of a generally reliable data base. Extrapolations from larger particle sizes and use of typical fractional efficiency curves were necessary since the available data were based upon measurement techniques incapable of quantifying particles below about 1 μm in size. Data collected since 1970 indicate that such extrapolations may have introduced large errors in the data base. Since data from direct measurement of many sources and collectors by use of recently developed fine particle sizing methods are now available, it is possible to develop a more accurate summary of stationary source fine particle emissions.

A rather obvious question to ask is "Why computerize the data?" A computerized information system would enable persons to access a current source of data. Moreover, a computerized data base could be used to process special requests for sorting or editing of data. For example, it would be a simple task for a computer to print a list of all sources in the data base which are controlled by baghouses. To compile such a list by hand would require hours. A computerized system would also allow for the almost continuous updating of new information. Test results could be entered into the system as the testing programs were completed. Then, periodically, a detailed addendum report analyzing the present state of the data base could be issued. Such a report could contain source priorities, evaluations of control technology, identification of data deficiencies, etc., and could be used to direct planning efforts for future test programs. Since the computerized data base lends itself to the ease of update and status reporting, it is clear that significant benefits could be achieved in the long run as it would no longer be necessary to undertake a major revision effort.

FPEIS Structure

The organization or structure of the FPEIS includes data elements sufficient to provide information and data for source test measurements. A data element is defined as a computer variable corresponding to a particular source test data item. The completeness of information for any given source test will be limited only by the availability of such information as contained in the test report or original reference from which the FPEIS input is derived.

The fundamental element of the system is the *test run*. A test run is defined as "any test measurement of a specific source for a specified length of time, in a specified location, with specific particle size measuring equipment." Associated with the test run are the relevant data for source operating characteristics, control device parameters, test characteristics, sampling conditions and any other information and data which describe the situation during the period of the test run. There are provisions for including supplemental information such as subsequent chemical analysis or biological testing of the collected sample. Additionally, provisions are also made for narrative comments which can be used to provide supplementary information, not elsewhere classified. Assignment of a test run number will be on an arbitrary basis by the encoder when the data are compiled for entry into the system.

Groups of test runs for a source testing program are contained within a *test series*. A given test series will usually consist of the information contained in a test report, technical journal, etc., specific to a given source-collector combination. Different test series will be distinguished by assignment of test series numbers from a master file listing. Initial test series numbers have been assigned on an arbitrary basis and future additions will be given master file numbers as received.

FPEIS Organization

FPEIS data are grouped into five general categories of information as shown in Table I. These are: source and test series related information, control system description, test characteristics, biological and chemical analyses results, particle size measurement equipment and size distribution data.

Source and test series related information. This group of data elements identifies the source that was tested, the source location, and fundamental reference information for the test series. An entry is provided for additional remarks or

data pertinent to the test series. To enable a general grouping of sources to be made, each source test series has been described in terms of the NEDS Source Classification Codes that are applicable.

TABLE I. FPEIS data elements.

1) SOURCE CHARACTERISTICS
- Source Category (SCC)
- Type of Operation (SCC)
- Feed Material Class (SCC)
- Operating Mode Class (SCC)
- Source Name
- Site Name
- UTM Zone Location and Coordinates
- Source Address (Street, City, State, Zip Code)

2) CONTROL DEVICES
- Generic Device Type
- Device Category
- Device Commercial Name
- Manufacturer
- Device Description
- Design Specification—Type and Value
- Operating Parameter—Type and Value

3) TEST CHARACTERISTICS
- Sub-Series Number
- Sub-Series Test Data
- Sub-Series Start and Finish Time
- Sampling Location and Description
- Source Operating Mode
- Source Operating Rate
- Feed Material Composition
- Volumetric Flow Rate
- Gas Temperature and Pressure at Sampling Location
- Moisture Content
- Percent Isokinetic Sampling
- Gas Composition
- Trace Gases in ppm
- Mass Train—Total Mass Concentration
- Mass Train—Front Half Mass Concentration
- Mass Train Comments
- Sub-Series Comments

4) BIOASSAY TESTING AND CHEMICAL ANALYSES
- Bioassay Test Type
- Bioassay Test Remarks and Results
- SAROAD Chemical ID
- Chemical Analysis Method
- Concentration in Range Above 10 μm
- Concentration in Range 10 to 1 μm
- Concentration in Range 1 to 0.1 μm
- Concentration in Range 0.1 to 0.01 μm
- Concentration in Range Below 0.01 μm
- Filter/Total Concentration

5) PARTICLE SIZE EQUIPMENT AND DATA
- Run Number
- Measurement Equipment Type
- Size Range Lower and Upper Limit
- Substrate
- Sampling Start Time and Duration
- Sampling Flow Rate
- Dilution Factor
- Sampling Train Temperature and Pressure
- Percent Moisture
- Particle Diameter Basis
- Concentration Basis
- Upper Diameter Boundary
- Density—Value and How Determined
- Resistivity—Value and How Determined
- Physical Properties Comments
- Run Comments
- Diameter Boundary
- Concentration

Control system description. This group includes a description of the control system used (if any) during this test series, and of pertinent design specifications and operating parameters for the control system. Standard nomenclature is to be used to describe the system and provide the minimum information and data required to adequately characterize the system, its design, and the operating conditions during the time of the test.

This information is arranged in a format which will allow maximum flexibility for cases where multiple devices exist on the same source as well as to provide adequate space for devices where extensive design and operational data are available. Furthermore, the device class data element provides standard nomenclature for designation of the state of development of the control device; that is, whether the device should be classified as conventional or novel, prototype or pilot scale, etc.

Test characteristics. This grouping identifies the test runs that were performed within the test series or sub-series. These data define the specific source operating parameters, stack gas conditions, and ancillary test results such as mass train, Orsat analysis, and physical measurements of the particulate sample (density, resistivity). Space is provided for additional remarks or data pertinent to the test run which may be of use to a potential FPEIS user.

Biological and chemical analyses. This group provides for data from biological testing and chemical analyses conducted with the particulate sample collected during the test subseries. The type of bioassay test and the result of the test are also identified. Types of bioassay tests which may be used include cytotoxicity, mutagenicity, inhalation, skin painting, and neonatal.

The chemical analysis group utilized the coding system for specific elements or compounds developed for the SAROAD/SOTDAT data base system as well as a codification of analysis methods from the same system. The data are to be reported on a size distribution basis in decades from 10 μm down to 0.01 μm, where available, as well as on a total mass basis.

Particle size equipment and data. This grouping provides identification of the particle size measuring equipment, specific run data and sampling conditions, and particle size distribution data from the particular test run.

FPEIS Today

The potential for sorting and arranging the data contained in the FPEIS is virtually limitless; however, the basic FPEIS Summary Report uses a specific format to display all of the information for a particular test series at a given site or location. This output format includes graphical display of particle size distribution data.

The development of the Fine Particle Emissions Information System (FPEIS) from concept to operational status had the following objectives:

(1) to establish a functional computerized data base on fine particle emissions and control;
(2) to collect and assimilate an initial loading of source test data;
(3) to analyze the collected data and produce a report containing the contents of the data base and the results of the analysis; and
(4) to produce an informative user guide and reference manual for FPEIS.

With the recent publication of the FPEIS Summary Re-

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port, Reference Manual, and User Guide, these objectives have been met and the FPEIS is now available for limited use. For the present, direct access to the FPEIS data base is restricted to EPA and its prime contractors on the FPEIS. In the near future, however, those users who have valid access to the National Computer Center at RTP will be allowed to retrieve information directly. Any other requests may be directed to the Industrial Environmental Research Laboratory, Research Triangle Park, NC, where they will be acted upon as promptly as possible.

FPEIS Future

Now that operational status of the FPEIS has been achieved, a new phase of work will begin. The principal activities in the next phase will be:

(1) to carry out a new data acquisition and assessment activity, and
(2) to survey the user community for suggestions for improving the FPEIS and its usability.

The FPEIS will be updated with new source test data on a periodic basis. Initially, the updates are likely to occur semiannually. This will be due in part to anticipated modifications to the data base as new users identify oversights or shortcomings in the structure, and also due to the expected influx of source testing data following the completion of the first summary report on FPEIS. Furthermore, it is desirable to develop as complete a data base as possible in the shortest possible time. The first series of updates will not only add new data to the data base but also fill gaps in the existing data base left unfilled by the initial loading. This is expected because no one report at present contains all of the required FPEIS data; therefore, follow-up action to fill these gaps will be necessary.

In later years, it will be desirable for groups performing particle sizing tests to compile the FPEIS data directly as part of their normal test procedure. Standardized data input forms can be provided to enable the tester to encode the data in the field. This would greatly expedite data acquisition activities and ensure that the data base stayed current.

At present, there are no plans to publish the complete contents of the data base with the FPEIS Summary Reports because the volume of computer printout would be too large. The output from the first FPEIS loading of data alone would be as much as 2000 pages. Clearly, such a volume of material precludes its publication; however, if individual users desire a complete copy of the FPEIS, it can be provided. It is more likely, though, that such users will have a specific output format in mind which is tailored more to their needs than the standard form.

Summary

The MRI Fine Particle Emissions Inventory has in the past been one of the most often referenced documents in particle control technology literature. Its role in the development of particle emission standards and control technology has been a major one. Now, the need to have a current, and more importantly, accurate emissions data base is clear. The Fine Particle Emissions Information System has been developed to assist scientists and engineers in satisfying that need. Through a continuing dialogue with the user community, the FPEIS will evolve into an even more useful and usable information system on fine particle emissions.

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